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Shortening Airbag Model Validation Time using Reduced Order Modelling

Abstract:
Reduced Order Modelling (ROM) can be used to improve the accuracy of CAE models while shortening numerical parameter calibration. Anindustrial example for airbag deployment case illustrates the value of AI/ROM technology applied to CAE. Today extensive and time-consuming iterations are needed for the calibration of airbag model parameters such as outflow discharge coefficient, inflator heat loss, which may not be measured precisely by tests. This impacts validation quality and delivery timing of airbag models for the synthesis car crash simulations. The choice of relevant airbag model parameter exploration range for validation is based on experience and trial & error approach and is limited by the computational cost of high-fidelity CFD coupled Finite Element simulation runs. ROM based methodology reduces the airbag validation time by testing thousands of parameter combinations in a time frame of days instead of weeks. Therefore, model quality can be improved as more combinations can be tested using Reduced Order Modeling than within Finite Elements standard approach. The capability of ROM to achieve this target is shown on an industrial airbag calibration study. The available ROM methods using Proper Generalized Decomposition (PGD) are explained as well as the choice of DOE (Design Of Experiments), together with the number of Finite Element simulations required for training the ROM model. The ROM results are then compared to the Finite Element simulations, for parameters outside the training set, and a good match is demonstrated. This shows that the parametric ROM model can be used for the calibration study. A series of linear impactor experimental tests has been conducted, by changing the airbag vent size, impactor mass and velocity. The impactor acceleration, displacement and airbag pressure time history curves obtained by the ROM model are compared to the experimental results for each set of parameters using ISO Score (CORA) ratings. The process for finding the best parameters sets among the more than 1000 combinations is fully automated and takes less than one hour. A final validation using a standard Finite Element simulation with the updated parameters is conducted and the results are compared and rated with each experimental test, including the above-mentioned time history curves and the airbag deployment kinematics.

Speakers:

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